

LauncherOne Small Launch Vehicle Propulsion Advancement

Completed Technology Project (2017 - 2019)



Project Introduction

Virgin Orbit, LLC ("Virgin Orbit") is currently well into the development for our LauncherOne (L1) small satellite launch vehicle. LauncherOne is a dedicated small satellite launch system manufactured and planned for launch in the U.S. that is designed to deliver approximately 300-500 kg of payload to Low Earth Orbit. L1 is a highly vertically integrated rocket system with major subsystems (liquid propulsion systems, tanks, and avionics) designed, developed, and manufactured in-house by Virgin Orbit at our Long Beach and Mojave, California facilities. We see beneficial technical alignment between the core capabilities of NASA Marshall Space Flight Center, Glenn Research Center and our LauncherOne development needs and risk areas. These areas can be divided into the following two categories, both of which advance the development of small satellite launch. Specifically, we will address the need for the development and commercialization of a small launch system in the areas of: (1) Additive Thrust Chambers and Nozzles – Integration of MSFC and GRC materials expertise with Virgin Orbit equipment and engineering for the next generation of thrust chambers and nozzles. Outcome of this work could potentially be deployed on existing Virgin Orbit manufacturing machines and be quickly commercialized. (2) Multi-Core Crossfed Launch Vehicle Systems– MSFC has expertise on crossfed launch vehicle systems that Virgin Orbit will apply to small launch vehicles. Utilizing multiple cores would enable the launch of small payloads to higher orbits and expand the commercial small launch vehicle market space. Through these efforts, NASA and Virgin Orbit will be able to design effective next-gen propulsion systems and enable future recommendations for the design and optimization of these systems to be used in launch vehicles resulting in better performing and more affordable systems for commercial and government customers, including NASA.

Anticipated Benefits

Through these efforts, NASA and Virgin Orbit will be able to design effective next-gen propulsion systems and enable future recommendations for the design and optimization of these systems to be used in launch vehicles resulting in better performing and more affordable systems for commercial and government customers, including NASA. These solicitations increase focus on collaborations with the commercial space sector that not only leverage emerging markets and capabilities to meet NASA's strategic goals, but also focus on industry needs. NASA's investments in industry partnerships can accelerate the availability of, and reduce costs for the development and infusion of, these emerging space system capabilities. While developing the technology to enable NASA's next generation of science and human exploration missions, we will grow the economy and strengthen the nation's economic competitiveness.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Virgin Orbit

Responsible Program:

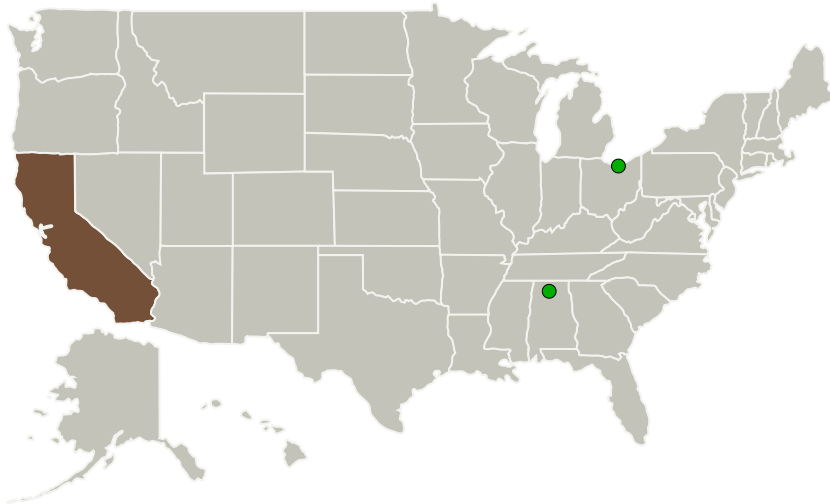
Flight Opportunities

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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Virgin Orbit	Lead Organization	Industry	Long Beach, California
● Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
● Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations

California

Project Transitions

 **October 2017:** Project Start

Project Management

Program Director:

Christopher E Baker

Program Manager:

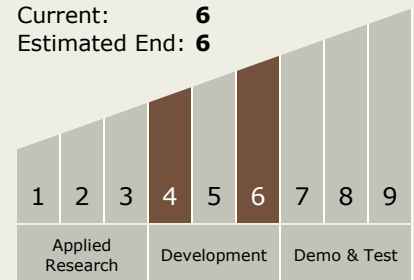
John W Kelly

Principal Investigator:

Sirisha Bandla

Technology Maturity (TRL)

Start: 4
Current: 6
Estimated End: 6



Target Destination

Earth

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- ✓ **March 2019:** Closed out
- Closeout Summary:** Successfully demonstrated additive manufacturing and hot-fire testing of bimetallic GRCop-84 and C-18150 channel-cooled combustion chambers using powder bed fusion and Inconel 625 hybrid directed energy deposition.

Project Website:

<https://www.nasa.gov/directorates/spacetech/home/index.html>